CANADA
DEPARTMENT OF MINES
HON. ARTHUR MEIGHEN, MINISTER; R. G. McCONNELL, DEPUTY MINISTER

GEOLOGICAL SURVEY
WILLIAM McINNES, DIRECTOR.

Summary Report, 1919, Part A

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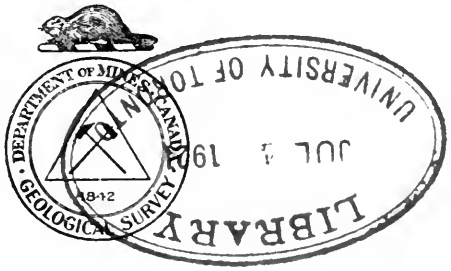

OTTAWA
THOMAS MULVEY
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1921

No. 1862

CANADA

DEPARTMENT OF MINES

Hon. Arthur Meighen, Minister; R. G. McConnell, Deputy Minister

GEOLOGICAL SURVEY

William McInnes, Director.

Summary Report, 1919, Part A

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OTTAWA
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26—1 No. 1862

To His Excellency the Duke of Devonshire, K.G., P.C., G.C.M.G., G.C.B.O., etc., etc., Governor General and Commander in Chief of the Dominion of Canada.

MAY IT PLEASE YOUR EXCELLENCY,—

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII, chapter 29, section 18, the Summary Report of the work of the Geological Survey, Department of Mines, for the calendar year ending December 31, 1919.

ARTHUR MEIGHEN,
Minister of Mines.

To the Hon. ARTHUR MEIGHEN,
Minister of Mines,
Ottawa.

SIR,—I have the honour to submit herewith the Director's Summary Report of the work of the Geological Survey, Department of Mines, for the calendar year ending December 31, 1919.

I am, sir, your obedient servant,

R. G. McCONNELL,
Deputy Minister.

SUMMARY REPORT, 1919, PART A

REPORT OF THE DIRECTOR

By William McInnes

INTRODUCTION

The work of the Geological Survey, during the field season of 1919, was spread, as in previous years, over the whole of Canada. The field over which exploratory and detailed work in geology and natural science might be extended with advantage to the Dominion is so wide that it is possible in one year to cover only a very small part. Consequently areas of work were chosen which in the judgment of the department most urgently needed examination.

In accordance with this choice, exploratory parties operated in Yukon, British Columbia, the area of the Great Plains, the Northwest Territories, Manitoba, Ontario, Quebec, and the Maritime Provinces.

The British Columbia office at Vancouver, in charge of C. Camsell, continued to meet the great demands made upon its staff, and worked in close co-operation with the Provincial Department of Mines (Part B, page 1).

For convenience of reference and economy in printing, the summary was again issued in parts covering geographical areas. The parts were published from time to time throughout the year as they were got ready. The following parts, which with Part A make up the summary report for the year, have been distributed:

Part B. Yukon and British Columbia.

Part C. The Great Plains area and north to the Northwest Territories.

Part D. Northern Manitoba.

Part E. Ontario and Quebec.

Part F. The Maritime Provinces.

Part G. Northern Ontario.

GEOLOGICAL FIELD WORK

W. E. Cockfield, in Yukon, explored geologically part of the Ogilvie range which extends from the Mackenzie mountains at the headwaters of Stewart river to the Yukon at the crossing of the 141st meridian. No deposits of present economic value are known within the area actually mapped, but the geological conditions are similar to those in the valley of Twelvemile river, where galena deposits occur, so that the district offers some inducement to prospectors. Prospecting, however, should be confined to those areas in the vicinity of igneous rocks.

A few days were spent by Mr. Cockfield in examining properties in the Mayo area, where high-grade silver ore has been opened up on Keno hill. Mr. Cockfield regards this deposit as of great importance and believes the field offers great promise to the mining man. (Part B, page 1.)

J. J. O'Neill spent the summer of 1919 in the Salmon River district, Portland Canal Mining Division, British Columbia, which has, during the past few years, attracted attention because of the discovery of silver ores, both high and low grade. Mr. O'Neill's work was almost exclusively confined to the high-grade ores, which are

found in quartz veins or silicified shear zones about the borders of the granodiorite porphyry intrusive. In Mr. O'Neill's opinion properties carrying these ores should be very carefully tested to determine the extent and general average of the ore before any heavy expense is undertaken in the purchase of mining machinery, or in the way of transportation improvements. Most of the values of the low-grade ores are in zinc, and it will be necessary to develop mining and metallurgical processes to treat this material before it can be utilized. (Part B, page 7.)

V. Dolmage, in continuation of a plan inaugurated in 1918, to make a geological and mineralogical survey of the west coast of Vancouver island, spent six weeks of the season of 1919 in mapping the shore and islands of Barkley sound. No minerals, except small quantities of alluvial gold, have been produced from this district since 1902, although copper has been spasmodically mined and shipped. Iron, also, has been mined in the form of a very pure magnetite, and may possibly be mined again if an iron and steel industry be established on the British Columbia coast. A mercury deposit near the Sechart whaling station, and, therefore, within easy reach of transportation, was examined by Mr. Dolmage, who is of the opinion that thorough prospecting for a commercial deposit of mercury in the vicinity of the whaling station is well justified.

Mr. Dolmage also visited the Sunloch copper deposit, situated on Jordan river, Vancouver island, discovered a few years ago, and now worked by the Consolidated Mining and Smelting Company. The deposits occur in a series of basic lava flows and tuffs which have been compressed into large folds and have been intruded by a number of stocks and dykes of gabbro. The managing director of the company estimated, at the end of 1918, that 100,000 to 150,000 tons of ore, averaging 3 per cent to 5 per cent copper, had been proved. Since that time the tonnage has been considerably increased. Mr. Dolmage believes the ore will continue to a great depth below the present workings. (Part B, page 12.)

C. Camsell, owing to the pressure of duties connected with the British Columbia office, was able to spend only a short time in the field. He visited the Coquihalla district, British Columbia, which extends from the town of Hope, on Fraser river, up the valley of Coquihalla river as far as Boston Bar creek, and includes a belt from 4 to 10 miles deep on either side of the river. Physical difficulties have, until quite recently, withheld prospectors from this area, but the opportunities now provided by the Kettle Valley railway appear likely to encourage mining activity. High-grade lode gold deposits have been developed in the area, but the similarity of its geological formations to those of the adjacent Siwash Creek district is alone sufficient to recommend it to the prospector.

Mr. Camsell examined, also, the silver deposits at Stump lake, Yale district, which were worked in the "eighties" but were afterwards practically abandoned. The veins are believed to have been formed by ascending thermal waters, and carry values mainly in silver, with lesser amounts of gold. Active development work was carried on during the summer of 1918 and sorted ore, yielding about $50 to the ton, was shipped during 1919. (Part B, page 39.)

B. R. MacKay spent two months of the field season, 1919, in studying placer deposits in the Horsefly River area, in examining an oil-shale prospect on Antoine creek, and in visiting the neighbouring deposits at Twentymile creek, Bullion, and Keithley creek, all in the Cariboo district. Mr. MacKay reports that capital—both English and American—is seeking investments in favourable-looking placer deposits and that a marked renewal of interest has been evinced in the gold quartz properties. He says that a most optimistic attitude is shared by every operator in the district. The great drawback to successful mining in this district is still, as it has always been, the lack of railway transportation, but the completion of the Pacific Great Eastern

railway to Quesnel, though the route does not pass through the mineral belt of Cariboo, will materially help to lower the cost of production. Mr. MacKay spent a month in the Barkerville district examining various placer deposits, and in visiting the quartz ledges on Proserpine mountain. (Part B, page 36.)

S. J. Schofield furnished a short report on the discovery of fossils in the Mesozoic rocks on Nickel Plate mountain, near Healey, on Similkameen river. These rocks were classed by Dawson, in 1877, as belonging to the Cache Creek group of Carboniferous age, but the echinoderm fragments discovered in the autumn of 1919 place the Nickel Plate formation in the same general horizon as the Nicola, Cultus, Marble Bay, and Sutton formations. (Part B, page 38.)

M. F. Bancroft devoted the field season of 1919 to a study of the general geology and structure of a portion of the Selkirk Mountain region, embraced in Slocan mining area, Kootenay district, British Columbia (Map 1667 [1916]). The area covers about 260 square miles in the Slocan and Ainsworth mining divisions. The mineralized areas between Kootenay and Slocan lakes form the basis of a considerable mining industry, yielding high-grade silver, lead, and zinc ores. The Slocan area has been responsible for a large proportion of the silver production of the province. Much information bearing on the geology and ore deposits of the Slocan is contained in the earlier reports of the Survey. (Part B, page 39.)

W. A. Johnston investigated the lower part of Fraser river and its delta, largely for the purpose of assisting the Department of Public Works to improve the navigable channels. A preliminary report was made to the Board of Engineers of the Department of Public Works in February, 1920, and a full report is in preparation. The board has under consideration the problem of navigation improvement of the Fraser.

L. Reinecke completed his examination of the area served by the Pacific Great Eastern railway between Lillooet and Prince George. His report, since published as Memoir 118, deals fully with the known deposits of the minerals in the vicinity of the railway, especially hydromagnesite, epsomite, chromite, and molybdenite.

W. S. McCann explored the Bridge River area of Lillooet Mining Division, B.C. He visited most of the gold claims, the principal of which are on Cadwallader creek, the silver-copper claims on McGillivray mount, and the antimony veins on that mount, and on Gunn and Taylor creeks. The mining industry of the area suffered greatly during the war period, but a revival of interest is anticipated, particularly in the gold quartz deposits.

E. M. Kindle continued the field work begun in the Mackenzie River basin in 1917 on the correlation and stratigraphy of the formations of that region. Particular attention was given to the stratigraphy of that portion of the Mackenzie valley in which oil has since been struck. Field work was extended to the northern limit of Devonian rocks near the Mackenzie. Great Bear river was ascended about 45 miles to a point above mount Charles. Silurian fossils were obtained from the Mount Charles section and from the Cap Mountain section east of Wrigley. Shorter trips were also made up the North Nahanni, Root, and Liard rivers. The collections secured represent, with those made in 1917, all the horizons of the Devonian of this region. A short report on a new iron ore horizon east of Wrigley was prepared. (Part C, page 1.))

J. S. Stewart was attached to a geological party sent out by the Provincial Government of British Columbia to investigate the oil and gas possibilities of the northeastern part of that province. No seepages of oil or gas were observed within the area examined, but at least two, and perhaps three, anticlinal folds have been traced, and though they are for the most part eroded well down into the lower part of the St. John shales, yet there is a possibility that porous absorbent sandy lenses occur in

places. Mr. Stewart thinks that any projected borings should penetrate at least the entire thickness of the Bullhead Mountain formation, a sandstone of freshwater deposition which appears to outcrop for the most part in the west of the area examined. This area may be roughly described as lying south and southeast of Hudson Hope, on Peace river. (Part C, page 3.)

J. MacVicar carried on exploration work in the coal areas northwest of Brûlé lake, an expansion of Athabaska river, Alberta. The coal measures have not, so far as known, been mapped, but they are found to occur mostly in the Kootenay formation, of which the upper part only is exposed in this area. The seams vary in thickness up to 5½ feet and the coal is bituminous, bright and clear, but friable.

Mr. MacVicar's explorations were a continuation of those made by him in 1916 a few miles to the west, where very thick seams—up to 100 feet thick—were found in probably lower beds of the same formation. (Part C, page 8.)

F. H. McLearn spent the field season in a reconnaissance examination of a part of Little Smoky river, a tributary of Smoky river, Peace river, Alberta. Owing to the scarcity of outcrops the results of the expedition make no important addition to our knowledge of the structural geology of the region. (Part C, page 13.)

B. Rose continued his examination of the coal areas of the Rocky mountains, and carried his investigations northward to cover the area drained by Highwood river. No coal has been worked in this area, and the measures have been prospected at only one locality, locally known as the Ford mine on Cat creek. Coal of economic importance is found in the Kootenay formation only. The coal is highly bituminous and most of the seams appear to be clean. The thickness of the seams ranges from 4 to 22 feet. (Part C, page 14.)

D. B. Dowling was employed during the field season of 1919 mainly in keeping in touch with the prospecting for gas and oil which was being carried on. He visited several of the drilling sites and the gasolene absorption plant south of Calgary. In his summary report he draws attention to the possibilities of oil production from the Devonian rocks that are buried beneath the Cretaceous of the eastern part of the plains. (Part C, page 20.)

E. L. Bruce made an examination of the belt of Precambrian rocks in which lie the headwaters of Hayes river, in northeastern Manitoba. Early geological exploration proved the existence of rocks in this region similar to those associated with the gold and copper ores north of the Saskatchewan, and a few prospectors for gold were attracted to the Knee Lake district, which lies about 125 miles northeast of lake Winnipeg. A few claims have been staked and some development work has been done, but the veins have proved disappointing. Those quartz veins found to be auriferous occur in fractured quartz-porphyry dykes. (Part D, page 1.)

F. J. Alcock collected data for the areal mapping of a rectangle including Pipestone lake and a part of Cross lake, northern Manitoba. The area was known to contain rocks similar to those found in the mineralized belt north of The Pas. The district, however, is not promising from a mining viewpoint, owing to the limited extent of rocks of the Pre-Granite Complex. A few gold claims have been staked on the north shore of Pipestone lake and on an island near where Nelson river empties into Pipestone lake. Assays of grab samples were not sufficiently promising to justify any large expenditure. (Part D, page 11.)

T. L. Tanton spent the season of 1919 in preparing an areal map of a well-known mineralized district on the north shore of lake Superior. Rocks of equivalent age to those which carry the celebrated iron and copper deposits of the south shore of lake Superior are represented in this section, but no concentrations of iron or copper of economic interest have been found. The fracture fillings in these Animikie and Keweenawan rocks, however, have been found to carry rich silver ores, as, for instance, at Silver islet. It is expected that the geological work will facilitate the tracing of

faults and the systematic prospecting of these may bring to light further deposits of value. (Part E, page 1.)

M. Y. Williams in addition to making a study of those oil-fields and prospects in southwestern Ontario not covered in previous work, examined an oil occurrence in a syncline in the Trenton formation of Dover West township, Kent county. This occurrence is specially interesting both because it is the only commercial production from the Trenton in Canada, and because the oil is known to occur in a syncline. The limit of the syncline and the oil pool has not yet been determined. (Part E, page 7.)

As the need for petroleum in Canada becomes more and more urgent, attention is being directed to the less known sedimentary basins as possible sources of supply. This department, co-operating with the Department of Mines, Ontario, undertook during the summer of 1919 the exploration of parts of the valleys of Mattagami, Abitibi, and Moose rivers. Mr. Williams was instructed to examine and make a report on these areas, and his views have been summarized in a short report, included in Part G, Summary Report, 1919. (Part G, page 1.)

H. C. Cooke explored the district west of Kirkland lake, but, from an economic standpoint the geological work proved disappointing. He made a hurried examination of the reported find of platinum in Otto township. Mr. Cooke believes the locality to be a good field for prospecting in the hope of obtaining a large-sized body of high-grade ore, but says that the ore-bodies hitherto found are too low grade and too small in size to be of any value for mining purposes. (Part E, page 18.)

M. E. Wilson spent the greater part of the field season of 1919 in completing the investigations in the Renfrew-Calabogie district commenced in 1918. This work included the completion of the geological examination of the Renfrew and Calabogie map-areas and the examination of the principal mineral deposits that occur within the Renfrew and Calabogie map-areas or in the territory adjacent to these areas. The mineral deposits that occur in this region are both numerous and varied and are in some cases extensive. The minerals of commercial importance represented in the deposits include graphite, pyrite, molybdenite, magnetite, hematite, and celestite. (Part E, page 19.)

A. Anrep carried on his investigations of peat bogs in Ontario and Quebec, examining areas containing over 20,000,000 tons of peat, the larger part of which is workable for fuel or other purposes. (Part E, page 44.)

W. H. Collins continued in 1919 a study of the iron formations of Michipicoten district, Ontario, which was begun in 1918. The hematite, siderite, and pyrite deposits constitute the chief mineral wealth of the district, and are integral parts of the iron formations; consequently, additional knowledge regarding the nature and distribution of the formations should facilitate the search and development of the iron ores and sulphur deposits that accompany them.

Study of the iron formations involved a systematic geological exploration of the whole district. Much time was also given to surveying canoe routes, for a surprisingly large part of the country is unknown except to a few trappers and resident prospectors. Sufficient geological and geographical data were collected to make, on a scale of one mile to an inch, a map of 500 square miles of country, suitable for prospecting and other exploratory needs.

Some of the gold-bearing properties discovered east of Goudreau during 1918 and 1919 were visited for the purpose of forming an opinion regarding their chances of successful development.

R. Harvie spent the season continuing his studies of the geology of the Thetford area, Quebec, within which occur the famous asbestos deposits, now producing 85 per cent of the world's supply, with a value, this year, of almost $11,000,000.

W. J. Wright spent most of the field season in the geological survey of the Moncton map-area and an examination of the oil-shale deposits of Albert county, N.B. His report on these oil-shales is being prepared for press. (Part F, page 1.)

E. R. Faribault was occupied during the field season of 1919 in geological investigations in Shelburne, Queens, and Yarmouth counties, Nova Scotia. The structural geology of Sable River and Lockeport map-areas was completed and detailed surveys were made of the Kemptville, Carleton, and Cranberry Head gold districts in Yarmouth county. A map on a scale of 2 miles to 1 inch was made of the Kemptville-Carleton area and large scale plans of the two gold districts.

The section of the Gold-bearing series exposed on the shore between Cranberry Head and Chegoggin point was examined and the Halifax slate formation outcropping there was found to be overlain conformably by a band of garnetiferous mica schist 36 feet in thickness, which may have value as a source of abrasive material; a 20-foot layer if iron pyrites, probably of too low a grade to be of value; and 350 feet of white quartzite which is of interest as a possible source of silica. (Part F, page 2.)

A. O. Hayes passed most of the summer in studying certain salt and coal deposits in Nova Scotia. A geological map of Malagash peninsula and a detailed topographical-geological map of the area known to be underlain by salt, together with Mr. Hayes' full report on the Malagash salt area, have since been published (Memoir 121). (Part F, page 20.)

J. Keele (Mines Branch) made a special examination of the Mesozoic clays in northern Ontario, particularly those in the valleys of the Missinaibi and Mattagami rivers. A synopsis of his views has been published as a separate report included in Part G, Summary Report, 1919. (Part G, page 13.)

DIVISION OF PALÆONTOLOGY

E. M. Kindle, Chief of the Division, spent the field season of 1919 in the Mackenzie district (page 3A). He reports that L. D. Burling continued work upon the Cambrian and Precambrian rocks of the Cordilleran region; that E. J. Whittaker collected fossils from the Devonian of the Liard valley; that Miss A. E. Wilson continued her studies of Ordovician sections in the Ottawa valley; that F. H. McLearn was occupied with field work in western Alberta (Part C, page 13); and that C. M. Sternberg, assisted by J. Skillen, spent the field season in the Red Deer River district, Alberta, collecting specimens of parts of dinosaurs and hadrosaurs. It has been the policy of the division to keep the viewpoint of modern ecology in studying fossils and to endeavour to interpret their stratigraphic significance in the light of the rapidly growing body of knowledge regarding sedimentation.

The Division of Vertebrate Palæontology and the department suffered an almost irreparable loss early in the year by the death of the chief of the division, Lawrence M. Lambe, which occurred on March 12, 1919. Mr. Lambe had been associated with the Geological Survey since 1885 and for the past fifteen years had devoted himself almost exclusively to vertebrate palæontology, on which subject he had published many authoritative memoirs. Pending the appointment of a successor, C. M. Sternberg has continued the work of the division under the supervision of Dr. Kindle.

DIVISION OF MINERALOGY

R. A. A. Johnston, Chief of the Division, reports that during 1919 great improvement has been made in the organization of the laboratories. M. F. Connor paid particular attention to the constitution of chrome ores from the Black Lake area, Quebec. This work will, it is hoped, lead to a better understanding and a more satisfactory exploitation of the ores of the area. E. Poitevin visited the Black Lake and Thetford asbestos deposits, and with H. V. Ellsworth made an extensive study of some remarkably fine inyoite specimens from the gypsum deposits of New Brunswick (Museum Bulletin 32). Over 500 specimens have been received for identification or comment as to their economic value.

Thanks of the department are due to the following gentlemen for donations to the Museum: Mr. P. Doucet, Manager, Amalgamated Asbestos Corporation, Ltd., Montreal; Mr. B. R. Freeland, Grand Forks, B.C.; Mr. N. H. Griffin, General Manager of the Rhodesian Asbestos Mines, Buluwayo, Rhodesia; Prof. A. Lacroix, Paris, France; Mr. R. E. Lenthall, Newport Island, Gaspe, Que.; Monsieur Albert Pelloux, Genoa, Italy; Mr. H. H. Rowatt, Controller of Mining Lands and Secretary of Yukon Branch, Interior Department, Ottawa; Mr. Shimmatsu Ichikawa of Kitashinjo-Mura, Imatategun, Fukui-ken, Japan; and to the following for advice and assistance in securing specimens for museum and educational purposes: Charles Brant, M.E., General Manager, the Eldorado Mining and Milling Company, Eldorado, Ont.; the George Gillespie Mining and Milling Company, Madoc, Ont.; the Anglo-American Mining and Milling Company, Madoc, Ont.; Stephen Wellington, Thomas Blue, Councillor Donald McKinnon, Thomas Henderson, L. Ashley, W.G. Douglas, Madoc, Ont.; Harry Smeaton and W. Nicholson, Queensborough, Ont.

Mr. Johnston, with W. D. Dalglish as assistant, visited Lyons, France, to take charge of the Canadian exhibit at the Lyons Fair, which was held in March. Sir George Foster, who paid an official visit to the Canadian section, expressed entire satisfaction with all the arrangements and intimated that he had decided to have the exhibits placed on view in Paris if suitable arrangements could be effected. The attendance at the Canadian section averaged over 14,000 daily, and was 30,000 on the closing day.

BORINGS DIVISION

E. D. Ingall, Chief of the Borings Division, reports that during the year the work continued along the lines hitherto followed. The work of collecting records of borings and sets of samples from the strata passed through was greatly facilitated in certain districts by the co-operation of the field geologists of the Geological Survey. Studies were made, microscopically and otherwise, of sets of samples from a number of wells in different parts of Canada. The results obtained and the correlations arrived at were communicated to the drillers for their use in the prosecution of their operations. Similar aid was rendered in a number of cases through a search of the published geological literature for data relating to districts where borings are in contemplation or in progress, in search for water, natural gas, or petroleum. In various other ways service was rendered to these interests throughout Canada.

—	No. of sample bags sent out	No. of samples received	No. of wells from which samples were received	No. of records received	No. of circulars sent out
Maritime provinces	2,900	2,232	11	9	
Quebec	150	64	2	17	475
Ontario	4,815	2,405	23	47	
Northwest provinces	800	211	3	1,560	
British Columbia	425	62	1	5	
Total	9,090	4,974	40	1,638	475

BIOLOGICAL DIVISION

R. M. Anderson, Acting Chief of the Division, reports that, although public exhibitions have been suspended during the occupation of the Victoria Museum by Parliament, many specimens have been examined by specialists, and educational exhibits have been arranged. John Macoun continued during the year his botanical work on Vancouver island. James M. Macoun spent much time in the determination

of specimens received from collectors in all parts of Canada, and, assisted by W. Spreadborough, worked in Jasper park, Alberta, and along the Grand Trunk railway to Vanderhoof, B.C. Mr. Macoun's health was very poor when he returned from the field in October, and he was obliged to undergo a serious surgical operation, and to the great loss of the department, he died shortly afterwards.

P. A. Taverner, zoologist (in charge of birds), accompanied by C. E. Johnson of this division, made a representative collection of the summer and breeding birds of Kapuskasing district, Ontario. The results are of considerable value.

C. L. Patch collected biological specimens and gathered information concerning the fauna of the northeastern part of Queen Charlotte islands. D. Blakeney collected birds and mammals in the vicinity of lac Seul, Kenora district, Ont.

J. Skillen, who accompanied the Chas. Sternberg palæontological party in 1919, brought back a small but most interesting collection of birds and mammals from Red Deer river, Alberta.

Dr. Anderson's time was largely occupied as general editor of Arctic reports for the Arctic Biological Committee.

The thanks of the division are due to many donors for notable additions to our collection, but especially to Mr. Ernest Thompson Seton, for a large number of specimens, many of them important from an historical viewpoint.

ANTHROPOLOGICAL DIVISION

E. Sapir, Chief of the Anthropological Division, reports that until the Victoria Museum, now occupied by Parliament, is restored to the Geological Survey, the Anthropological Division is greatly handicapped by lack of space; that C. M. Barbeau made a trip to Lorette, Que., to secure information relating to the Huron Indians; that F. W. Waugh made inquiries into the ethnology of the Ojibwa of lac Seul, Kenora district, Ont.; and that Harlan I. Smith initiated work near Massett, Queen Charlotte islands, which is expected to throw light on the history of the West Coast culture. Dr. Sapir himself spent the greater part of the year in linguistic researches.

Physical Anthropology

The division lost the services of F. H. S. Knowles, who resigned. A successor has not yet been appointed.

PHOTOGRAPHIC DIVISION

G. G. Clarke, Chief Photographer, reports that the following work was done by the Photographic Division during the calendar year 1919:

Contact prints	3¼ x 4¼ to 36 x 48	14,126
Bromide enlargements	4 x 5 " 40 x 72	658
Exposures developed	3¼ x 4¼ " 6½ x 8½	3,636
Dry plate negatives	4 x 5 " 11 x 14	361
Wet plate negatives	8 x 10 " 24 x 30	202
Photostat copies	7 x 11 " 11 x 14	147
Photo zinc plates	11 x 14 " 26 x 32	41
Proofs from zinc's	11 x 14 " 26 x 32	92
Lantern slides	3¼ x 4	462
Photos and titles mounted		1,817

LIBRARY

Mrs. F. E. Forsey, Acting Librarian, was in charge of the library during the year; she reports that the additions to the library during the year 1919, were as follows: books purchased, 447; volumes received by gift, 488; periodicals subscribed for, 4; periodicals re-subscribed for, 145; pamphlets received, 151; maps received, 83; volumes bound during the year, 498.

A notable addition was made to the library during the year in the purchase of the valuable scientific library of the late Dr. Watt, of Montreal.

The map collection was further enriched by fifty charts of Canadian waters purchased from the British Admiralty, seventy-eight charts presented to the library by the Hydrographic Survey of Canada, and one hundred and sixteen lake charts received from the Northern and Northwestern Lakes Survey of the United States War Department.

DISTRIBUTION OF PUBLICATIONS, 1919

During the year 1919, 69,543 publications of the Geological Survey, exclusive of the French editions, were distributed. Of these, 41,640 were distributed in compliance with written and personal requests, and 27,903 were sent to addresses on the mailing lists.

In the case of French translations of Geological Survey publications, the Publishing and Translating Division, Department of Mines, reports that during 1919 7,242 copies were distributed. Of these, 5,693 were distributed in compliance with written and personal requests, and 1,549 were sent to addresses on the mailing lists.

MUSEUM

The Victoria Memorial Museum building continued to house the Parliament of Canada, so that the exhibits remained in storage, excepting the collection of minerals which was open to the public at 227 Sparks street.

The preparation of exhibition groups was continued by the Museum staff in preparation for the re-occupation of the Museum building.

The practice of providing illustrated lectures to the public on topics of general interest was continued throughout the year, though such lectures had to be given elsewhere than in the Victoria Museum. Altogether twenty-three lectures were given on seventeen different subjects by eight lecturers.

TOPOGRAPHICAL DIVISION

W. H. Boyd, Chief Topographer, reports as follows on the work of the year, 1919:

The following topographers, who have been serving with the Canadian Expeditionary Forces, have returned and resumed their work with the division: S. C. McLean, A. G. Haultain, J. R. Cox, and E. E. Freeland.

Mapping

Locality	Topographer-in-charge
Head of Salmon river, Portland canal, B.C.	F. S. Falconer.
Britannia Beach area, B.C.	K. G. Chipman.
North Thompson river, B.C.	D. A. Nichols.
Peace River oil district, Sask.	K. G. Chipman.
Calabogie area, Ont.	C. H. Freeman.
Black Donald Graphite Co., and Renfrew Molybdenum Co. properties, Ont.	C. H. Freeman.

Control

Locality	Triangulator-in-charge
Britannia Beach and Vancouver, B.C. Triangulation control for Britannia Beach work and connexion to Vancouver	S. C. McLean.
Caribou, B.C. Triangulation control	S. C. McLean.
Michipicoten, Ont. Traverse control for geographical mapping	R. C. McDonald.
Maccan, N.S. Triangulation control	R. C. McDonald.

Fraser River Investigation

In addition to the regular work, the division was authorized to undertake the topographical surveying and mapping for the Board of Engineers, Department of Public Works, in connexion with their Fraser River investigation.

The topographical mapping required consists of a general map, on the scale of 2,000 feet to the inch with a contour interval of 20 feet, of the region embraced in the study of the Lower Fraser river. This area includes the Fraser River delta, Vancouver, and Burrard inlet, and extends easterly as far as Pitt lake and Port Haney. Detail maps, on the scale of 1,000 feet to the inch, with a contour interval of 5 feet, were also required of Fraser river, from Sand heads to Douglas island above New Westminster; the north arm of Fraser river, and Burrard inlet from Prospect point, Vancouver, to Port Moody; the north arm of Burrard inlet was not included.

The detail maps being required first, they were undertaken this year. Field work was started early in May and was completed before the end of December, despite the fogs and rain that prevail throughout that locality in the late autumn. It was owing entirely to the energy and determination of the topographers that the field work was brought to a successful completion. The topographers in charge of the different areas were: A. C. T. Sheppard, Fraser River survey; J. R. Cox, north arm of the Fraser River survey; A. G. Haultain, Burrard Inlet survey.

The detail mapping when completed will consist of eighteen map sheets and three mathematical control sheets.

The control for the elevations throughout the work was furnished by the Geodetic Survey of Canada. Lines of precise levels were run and permanent and temporary bench-marks established over the whole region.

This division furnished the Hydrographic Survey, for use in connexion with their part of the investigation, with a control sheet, on the scale of 2,000 feet to the inch, showing the locations of triangulation stations, lighthouses, pile beacons, etc., between Sand heads and Point Grey.

S. G. Alexander of the draughting division was attached to the division to assist in all the work and has rendered very efficient services.

The division is indebted to Mr. K. M. Cameron, Assistant Chief Engineer, Department of Public Works, for materially assisting in the success of the work by providing facilities for transportation and housing for the field parties; to Dr. W. Bell Dawson, Superintendent of the Tidal and Current Survey, for tidal data received and for valuable advice in the various problems regarding the tides; to Mr. C. C. Worsfold, District Engineer, and Mr. F. H. Sheppard, Superintendent of Dredges, Department of Public Works, for their ready co-operation and assistance.

GEOGRAPHICAL AND DRAUGHTING DIVISION

C.-Omer Senécal, Geographer and Chief Draughtsman, reports that the work of this division was carried on on the same general lines as in previous years, the staff remaining unchanged. During the year, forty-one new maps were published and nineteen are, at present, in the hands of the King's Printer for engraving, lithographing, and printing. Thirty-five other maps are in the office in various stages of progress. Besides the above, a large number of sketch maps, diagrams, and figures were drawn for illustrating memoirs, etc.

Duties of the chief of this division in connexion with the Geographic Board of Canada were, as usual, attended to.

The following are lists of maps in progress at the Printing Bureau, and maps published during the past year:

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Maps in Hands of the King's Printer, December 31, 1919

Number	Title	Date of requisition
	Dominion of Canada, base-map; scale, 100 miles to 1 inch	Dec. 10, 1919.
1784 to 1792	Nine geological diagrams of mine workings, Ainsworth Mining camp, Kootenay district, B.C.	Dec. 2, 1919.
1641	Sandon, Kootenay district, B.C.; scale, 4,000 feet to 1 inch. Topographical map	July 4, 1919.
1584	Blairmore, Alberta, geology; scale, $\frac{1}{62,500}$	Aug. 8, 1918.
1752	Monitor, Alberta; scale, 3 miles to 1 inch. Topographical map	April 15, 1919.
1766	Explored routes in a belt traversed by the Canadian National railways, between Penhurst and Longlac, Ont.; scale, 4 miles to 1 inch	Nov. 29, 1919.
1553	Portions of the districts of Algoma, Sudbury, and Timiskaming, Ont.; scale, 8 miles to 1 inch	Dec. 11, 1919.
1793	Matachewan, Timiskaming county, Ont.; scale, 1 mile to 1 inch	Nov. 24, 1919.
1756	Beauceville, Beauce county, Que.; scale, 4,000 feet to 1 inch. Topographical map	Nov. 8, 1919.
1707	New Glasgow, Pictou county, N.S.; scale, 2,000 feet to 1 inch. Topographical map	July 2, 1919.

Geological Survey Maps Published During the Year 1919

Number	Title	Remarks
	Canada	
1746	Occurrences of platinum in Canada; scale, 200 miles to 1 inch	Economic geology.
1585	Mackenzie River basin, northwestern Canada; scale, 50 miles to 1 inch	Geology.
	British Columbia	
1706	Anyox, Cassiar district; scale, $\frac{1}{12,000}$	Topography.
1708	Bridge river, Lillooet district; scale, $\frac{1}{125,000}$	Topography.
1731	Mineral areas in the vicinity of Hazelton, Cassiar district; scale, 1·66 miles to 1 inch	Geology.
1732	Principal veins on mining properties, head of Juniper creek, Rocher Déboulé range; scale, 875 feet to 1 inch	Geology.
1741	Sketch map of Copper mountain, Lillooet mining division; scale, 1,600 feet to 1 inch	Geology.
	Traverse sections of the principal placer deposits, Cariboo district; scale, 200 feet to 1 inch	Geology.
1733	Principal veins on the Silver Standard mine, Hazelton; scale, 400 feet to 1 inch	Geology.
	Plan and elevations of main workings, Silver Standard mine, 1917, Hazelton; scale, 100 feet to 1 inch	Geology.
1742	Ainsworth, Kootenay district; scale, $\frac{1}{24,000}$	Topography and geology.
1749	Diagram showing mineral claims, Ainsworth mining camp, Kootenay district; scale, 2,400 feet to 1 inch	
	Prairie Provinces	
1774	Relief map of the Prairie provinces; scale, 100 miles to 1 inch	Physiography.
1775	Structure contours showing top of Belly River sands; scale, 100 miles to 1 inch	Geology.
1776	Structure contours showing top of Lower Pierre shale; scale, 100 miles to 1 inch	Geology.
1777	Diagram showing depth from surface to top of Lower Pierre shale; scale, 100 miles to 1 inch	Geology.
1778	Structure contours showing Medicine Hat gas horizon; scale, 100 miles to 1 inch	Geology.
1779	Structure contours showing gas horizon near base of Colorado group; scale, 100 miles to 1 inch	Geology.
1780	Sketch of basin occupied by Upper Cretaceous sediments; scale, 100 miles to 1 inch	Geology.

Geological Survey Maps Published During the Year 1919—*Concluded*

Number	Title	Remarks
	Prairie Provinces	
1781	Structure contours showing oil and gas sand at base of Cretaceous; scale, 100 miles to 1 inch	Geology.
1782	Diagram showing depths from surface to oil and gas sand; scale, 100 miles to 1 inch	Geology.
	Well sections, arranged in west-east order, showing correlation of the geological formations	Geology.
	Welt sections, arranged in west-east order in relation to sea-level	Geology.
	Well sections, arranged in south-north order, showing correlation of the geological formation	Geology.
	Well sections, arranged in south-north order, in relation to sea-level	Geology.
	Alberta	
1724	Sheep River; scale, $\frac{1}{62,500}$	Topography and geology.
	Saskatchewan and Manitoba	
1726	Athapapuskow Lake region; scale, 3 miles to 1 inch	Geology.
	Manitoba	
1763	Portions of Rex group of claims, Wekusko lake; scale, 200 feet to 1 inch	Geology.
	Ontario	
1750	Geological structure of the oil regions of Lambton county and adjacent portions of Middlesex and Kent counties; scale, 4 miles to 1 inch	Geology.
1758	Galena-calcite veins on lot 23, con. VI, Fitzroy township, Carleton county; scale, 400 feet to 1 inch	Geology.
	Diagrams illustrating sedimentation	Geology.
	Diagram showing sections along the Niagara escarpment of Ontario peninsula and Manitoulin island	
	Characteristic geological sections in Ontario peninsula	
	Diagram showing formations near Detroit river	
	Ontario and Quebec	
1739	Portions of Bristol, Onslow, McNab, Fitzroy, and Torbolton townships, Pontiac, Carleton, and Renfrew counties; scale, 1 mile to 1 inch	Geology.
	Quebec	
1680	Portions of Grenville, Harrington, Chatham, and Wentworth townships, Argenteuil county; scale, 1 mile to 1 inch	Geology.
1705	Thetford; Megantic, Wolfe, and Frontenac counties; scale, 4,000 feet to 1 inch	Topography.
1747	Stone available for road construction in the city and district of Montreal; scale, 1·15 miles to 1 inch	Economic geology.
1757	Molybdenite deposits exposed on lots 9 and 10, range VII, Onslow township, Pontiac county; scale, 400 feet to 1 inch	Geology.
1759	Iron ore deposits exposed on lots 21 and 22, range II, Bristol township, Pontiac county; scale, 400 feet to 1 inch	Geology.

PUBLICATION DIVISION

Marc Sauvalle, Chief of Publishing and Translating Division, reports that the following memoirs, museum bulletins, and summary reports were published during the calendar year 1919:

English Reports

1564. Memoir 104, Biological Series 3. *Birds of Eastern Canada*—by P. A. Taverner; pp. i-iii, 1-297; coloured plates, 50; figures, 68; edition, 7,000 copies; published, October 29, 1919.

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1703. Memoir 111, Geological Series 91. *The Silurian geology and faunas of Ontario peninsula, and Manitoulin and adjacent islands*—by M. Y. Williams; pp. i-v, 1-195; plates, 34; figures, 6; maps, 2; edition, 2,500 copies; published September 25, 1919.

1713. Memoir 108, Geological Series 92. *The Mackenzie River basin*—by Charles Camsell and Wyatt Malcolm; pp. i-ii, 1-154; plates, 14; figure, 1; map, 1; edition, 3,000 copies; published, July 11, 1919.

1722. Memoir 116, Geological Series 98. *Investigations of the gas and oil fields of Alberta, Saskatchewan, and Manitoba*—by D. B. Dowling, S. E. Slipper, and F. H. McLearn; pp. i-ii, 1-89; plate, 1; figures, 4; maps, 9; edition, 3,500 copies; published, December 24, 1919.

1730. Memoir 107, Geological Series 90. *Road materials in the vicinity of Regina, Saskatchewan*—by L. Reinecke; pp. i, 1-28; map, 1; plates, 2; figures, 3; edition, 2,500 copies; published, May 1, 1919.

1734. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1917, Part F;* pp. 1F-36F; map, 1; figure, 1; edition 3,000 copies; published March 12, 1919.

1735. Memoir 109, Geological Series 94. *The Harricanaw-Turgeon basin, northern Quebec*—by T. L. Tanton; pp. i-iv, 1-84; plates, 9; figures 2; map, 1; edition, 2,500 copies; published, August 14, 1919.

1736. Memoir 110, Geological Series 89. *Preliminary report on the economic geology of Hazelton district, B.C.*—by J. J. O'Neill; pp. i-iv, 1-51; plates, 10; figures, 5; maps, 3; edition, 2,500 copies; published, June 14, 1919.

1738. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1917, Part A;* pp. 1A-19A; edition, 3,000 copies; published, March 26, 1919.

1740. Memoir 112, Geological Series 93. *Geology of the disturbed belt of southwestern Alberta*—by J. S. Stewart; pp. i-iii, 1-71; plates, 5; map, 1; edition, 2,500 copies; published July 22, 1919.

1743. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1918, Part B;* pp. 1B-72B; figures, 5; map, 1; edition, 3,000 copies; published, April 2, 1919.

1744. Museum Bulletin 29, Geological Series 36. *The discovery of a portage fauna in the Mackenzie River valley*—by E. M. Kindle; *New species of pelecypods from the Cretaceous of northern Alberta*—by F. H. McLearn; pp. 1-22; plates, 5; edition, 2,500 copies; published, October 18, 1919.

1745. Memoir 113. Geological Series 96. *Geology and mineral deposits of a part of Amherst township, Quebec*—by M. E. Wilson; pp. i-iii, 1-54; plates, 7; figures, 3; maps, 2; edition, 2,500 copies; published, October 8, 1919.

1748. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1918, Part G;* pp. 1G-19G; map, 1; edition, 3,000 copies; published, September 18, 1919.

1755. Memoir 114, Geological Series 95. *Road material surveys in the city and district of Montreal, Quebec*—by Henri Gauthier; pp. i, 1-52; plates, 4; figure, 1; map, 1; edition, 2,500 copies; published, September 25, 1919.

1760. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1918, Part C;* pp. 1C-52C; figure, 1; edition, 3,000 copies; published, September 18, 1919.

1762. Museum Bulletin 30, Geological Series 37. *Gabbros of East Sooke and Rocky point*—by H. C. Cooke; pp. 1-48; figure, 1; map, 1; edition, 2,000 copies; published, November 15, 1919.

1764. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1918, Part D;* pp. 1D-19D; edition, 3,000 copies; published, September 18, 1919.

1768. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1918, Part F;* pp. 1F-36F; figures, 3; edition, 3,000 copies; published, September 18, 1919.

1769. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1918, Part E;* pp. 1E-47E; figures, 7; map, 1; edition, 3,000 copies; published October 31, 1919.

1794. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1918, Part A;* pp. 1A-20A; edition, 3,000 copies; published, December 1, 1919.

Report of the Canadian Arctic Expedition 1913-1918—volume III: *Insects—Separates:*

Part A, *Collembola*—by Justus W. Folsom; pp. 1A-29A; plates, 8; edition, 3,000 copies; published, July 10, 1919.

Part B, *Neuropterid insects*—by Nahan Banks; pp. 1B-5B; plate, 1; edition, 3,000 copies; published, July 11, 1919.

Part C, *Diptera: Crane-flies*—by C. P. Alexander, *Mosquitoes*—by H. G. Dyar, *Diptera*—by J. R. Malloch, pp. 1C-90C; plates, 10; edition, 3,000 copies; published, July 14, 1919.

Part D, *Mallophaga*—by A. W. Baker, *Anoplura*—by G. F. Ferris and G. H. F. Nuttall, pp. 1D-12D; plate, 1; edition, 3,000 copies; published, September 12, 1919.

Part E, *Coleoptera: Forest insects*—by J. M. Swaine, *Carabida and sulphida*—by H. C. Fall, *Coccinellida*—by C. W. Leng, *Dystiscida*—by J. D. Sherman, jr.; pp. 1E-27E; plates, 3; edition, 3,000 copies; published, December 12, 1919.

Part F, *Hemiptera*—by Edward P. van Duzee; pp. 1F-5F; edition, 3,000 copies; published, July 11, 1919.

Part G, *Hymenoptera and plant galls: Sawflies-tenthredinoidea*—by Alex. D. MacGillivray, *Parasitic hymenoptera*—by Chas. T. Brues, *Wasps and bees*—by F. W. L. Sladen, *Plant galls*—by E. P. Felt; pp. 1G-38G; plates, 2; edition, 3,000 copies; published, November 3, 1919.

Part H, *Spiders*—by J. H. Emerton, *Acarina*—by N. Banks, *Chilopoda*—by R. V. Chamberlin; pp. 1H-22H; plates, 4; edition, 3,000 copies; published, July 14, 1919.

Report on *Indian canoes*—by F. W. Waugh. Reprint from the Ottawa Naturalist; edition, 350 copies; published, November 4, 1919.

Report on *birds of Red Deer river*—by P. A. Taverner. Reprint from the Ottawa Field Naturalist; edition, 250 copies; published, September 18, 1919.

Report on *field study of life histories of Canadian mammals*—by R. M. Anderson; edition, 250 copies; published, November, 1919.

French Translations

1753. *Rapport sommaire de la Commission géologique, du ministère des Mines, pour l'année civile 1917, Partie A;* pp. 1A-19A; edition, 1,000 copies; published, June 17, 1919.

1761. Mémoire 103, Série géologique 86. *Le comté de Timiskaming*—by M. E. Wilson, pp. i-vi, 1-177; plates, 16; figures, 6; map, 1; edition, 1,000 copies; published, October 9, 1919.

1765. Bulletin du Musée no 27, Série géologique 35. *Etude sur la minéralogie du district de Black Lake, Québec*—by Eugène Poitevin and R. P. D. Graham; pp. 1-103; plates, 12; figures, 22; edition, 1,000 copies; published, November 20, 1919.

ACCOUNTANT'S STATEMENT

By P. R. Marshall

The funds available for the work and the expenditure of the Geological Survey for the fiscal year ending March 31, 1919, were:

—	Grant	Expenditure
	$ cts.	$ cts.
Amounts voted by Parliament	500,504 64	
Civil list salaries		202,008 03
Explorations in British Columbia and Yukon		29,982 78
Topographical surveys in British Columbia		12,803 73
Explorations in Northwest Territories		23,015 04
Topographical surveys in Northwest Territories		4,579 25
Explorations in Ontario		10,652 71
Topographical surveys in Ontario		3,568 04
Explorations in Quebec		6,903 46
Explorations in Nova Scotia		4,934 32
Topographical surveys in Nova Scotia		1,214 14
Explorations in general		1,220 40
Palæontological investigations		2,887 15
Ethnological investigations		2,697 28
Boring operations		3,442 50
Publication of reports		23,380 74
Translation of reports		275 55
Publication of maps		6,722 06
Wages, temporary employees		21,574 87
Stationery, mapping material, and sundry printing		6,949 80
Miscellaneous		4,661 03
Library		4,205 74
Instruments and repairs		2,215 59
Civil government contingencies		2,000 00
Photographic supplies		1,813 04
Specimens for Museum		1,364 63
Laboratory		903 11
Postages and telegrams		874 76
Lyons Fair		772 98
Biological Division		558 01
Compensation to J. F. Lyons in lieu of quarters, fuel, and light		400 00
Miscellaneous gratuities		600 00
War bonus		16,619 64
Balances of advances unaccounted for in 1918-19 to be accounted for in 1919-20		2,500 00
Balance unexpended and lapsed		92,204 26
	500,504 64	500,504 64

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Summary

——	Grant	Expenditure	Grant not used
	$ cts.	$ cts.	$ cts.
Civil government appropriation	248,385 00	202,008 03	46,376 97
Explorations and surveys in Canada	130,000 00	113,678 18	16,321 82
Publication of reports and maps	55,000 00	30,378 35	24,621 65
Purchase of books, instruments, miscellaneous	45,000 00	41,251 55	3,748 45
Purchase of specimens	2,500 00	1,364 63	1,135 37
Compensation to J. F. Lyons for quarters, fuel, and light	400 00	400 00	
Civil government contingencies	2,000 00	2,000 00	
Miscellaneous gratuities	600 00	600 00	
War bonus	16,619 64	16,619 64	
	500,504 64	408,300 38	92,204 26

Casual Revenue

Sales of equipment	$ 232 04	
Sales of publications	37 70	$ 269 74

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